An Analysis of the Effect of Income on Life Insurance

Justin Bryan

Austin Proctor

Kathryn Stoklosa

Abstract

This paper aims to analyze the relationship between the gross national income per capita and the premiums per capita of life insurance in the Organization for Economic Co-operation and Development (OECD) countries. The data used comes from OECD.org, a collection of data from the OECD countries collected over the time period of OECD's existence. We analyzed data over a three year period, from 2010 to 2012, using data from 22 of the 46 OECD countries. We included a total of six variables in our restricted model: gross national income per capita, life expectancy, youth dependency population (0-17), long term interest rates, life insurance as share of the entire insurance market, and fertility rate. In both our simple and multiple regression models, we can see the positive correlation between gross national income per capita and premiums per capita of life insurance. This brings us to state that there is a statistically significant positive correlation between the level of gross national income per capita and the premiums per capita of life insurance in OECD countries.

Introduction

Insurance in its nature is a form of risk aversion. For a transfer of payment to an insurer, an individual receives a promise that, when it is needed, the insurer will compensate the insured for their financial loss in case of an accident or emergency. Auto, house, health; all these forms of insurance have the fact that they benefit the insurer in a direct financial way. These forms of insurance are a risk aversion for the insured, for a monthly fee they are promised that if they need help then the insurance company will assist them.

Life insurance, on the other hand, has a different form of risk aversion. Upon death, the insured has guaranteed that the insurer will pay his or her beneficiaries a predetermined lump sum. Life insurance is different because, unlike the other forms of life insurance, it does not directly benefit the insured individual. This fact makes life insurance a very unique form of insurance, that not everyone takes advantage of. Some individuals see life insurance as an optional form of insurance, while other forms of insurance may be necessary.

Individuals with a family tend to have a higher desire for life insurance, since they see themselves as providers for their family, and wish to provide for those they are leaving in death. Individuals with no family ties may not see life insurance as necessary, since they would have no clear beneficiaries to leave the benefits to. These life insurance policies are paid for in premiums, which are the amount of money an individual is charged for the coverage. These premiums vary in price according to the risk involved for the insurer, the dollar amount of the policy, and the health situation of the insured. The risk involved for the insurer can depend on many factors. Mostly economic factors, controlled by the country in which the insurance transaction is taking place.

A strong economy promotes stability and increased income, which makes insurance less risky to buy and provide. If an individual is confident in paying his or her premium will result in their beneficiary receiving the full sum promised, the individual will be much more likely to purchase the policy. Knowing this, we can assume that there will be a positive correlation between the ability to pay premiums for life insurance and an increase in premiums paid. Or rather, that with a higher income, there will be an increase in life insurance demanded. Due to this fact, we see the tendency of life

insurance to be bought in countries which have superseded a level of national income not found in undeveloped countries.

Our hypothesis is that as income increases the premiums per capita will increase as well in developed countries. Life insurance is not a necessity to survival or comfort, nor is it something mandated by a governing body. Thus with the idea that amount spent on life insurance premiums is positively correlated with income we can assume that as income rises then the premiums per capita will also rise.

Literature Review

The cross-sectional data of Life Insurance demand among OECD countries proved to be sufficient in the process of predicting correlations between the socioeconomic and macroeconomic factors. In depth information for many individual countries from the year 2011 was evaluated in literature by Basurto; Romero (2012) in addition to information on OECD countries from years 1993-2000 in literature by Li; Moshirian; Nguyen; Wee (2007).

Countries across the globe were affected by a variety of factors such as economical and financial crises, natural disasters, high market volatility and lingering low interest rates that had various effects on Life Insurance demand. No significant correlation was apparent between regional performances (euro zone countries, the Americas, etc.). The following will discuss the most common factors affecting Life Insurance premium growth in the OECD and other reporting countries.

The macroeconomic environment was a factor that had a negative impact on a number of countries with advanced economies. Some countries in the euro zone area, such as Finland, Portugal and Italy experienced significant decreases of more than 20% in life insurance premiums. This was attributed to sluggish growth in these economies. Other countries such as Greece were affected by their own economic crises that negatively impacted life insurance premiums.

Australia, the United States and other OECD countries around the world such as Switzerland and Spain experienced positive premium growth due to many factors such as an overall growth in disposable income, growth in the economy, growth of individual annuities and life policies, and lower volatility of financial markets.

Factors such as disposable income, education level, social security expenditure and number of dependents played an integral role in determining demand for life insurance among 30 OECD

countries. Positive relationships were shown between life insurance demand and disposable income as well as number of dependents and financial development. Social security expenditure was one factor that seemed to have various effects on demand. There was no consistent evidence that social security expenditure was strongly correlated with life insurance demand.

Income played an especially large role in determining the demand for life insurance. An increase of 1% in aggregate disposable income was attributed to a 0.6% increase in life insurance sales among OECD countries. Financial development per country was another factor that had a significant effect on the outcome. As financial development increased per country there was strong correlation with increase in life insurance sales. Higher inflation rates were proven to show strong negative correlation with demand for life insurance. The case was also the same with the real interest rate. As the real interest rate increased in OECD countries, there was a decrease in demand for the life insurance.

Information on life insurance demand among various dynamic household changes by Liebenberg; Carson; Dumm (2012) was also proven to be significant in the research conducted. This provided information on life insurance demand of households (ranging from years 1983 to 1989) who had recently experienced significant life events such as divorce, retiring, having a child, or becoming unemployed.

Data from this study suggested a positive relationship between purchasing life insurance and having a new child as well as starting a new job. Negative relationships were also found, such as unemployment in a household resulting in terminated life insurance. While this information did not specifically complement the other data, it provided a useful and insightful look at other factors that could potentially affect the life insurance market.

We believe our paper will show using national income per capita is a better predictor of the spending habits of a country rather than using gross domestic product (GDP) per capita as the main predictor. While looking at GDP per capita may be an accurate representation of the economic performance of the country per individual, using the national income per capita better captures the ability of the individual to pay for specific goods, such as life insurance premiums. Some countries GDP per capita may be at a high level, but the spread among the population may not be equal. By using this data, we see there is a threshold of income per capita which must be superseded before life insurance is a viable option.

Data

The main focus of this study is the effect of gross national income per capita on the life insurance premium per capita expenditure in OECD countries. The dependent variable in the model is the life insurance premium per capita expenditure, which was calculated from the total life insurance premiums expenditure for the year divided by the population of that country, in the years 2010-2012. For the three year period we started with 85 data points and missing or estimated data dropped the total to 57 points from 22 countries (Exhibit 1). All of the data was obtained from the OECD online database.

Based on the variables used in previous studies and some of our own thoughts on the subject we decided upon ten independent variables, found in Table 1, for the unrestricted multiple regression, and the restricted model was reduced to six independent variables, found in Table 2. If our hypothesis proves to be true then there should be an increase in the life insurance premium per capita expenditure with an increase in the gross national income per capita. The regression models are as follows:

Simple Regression:

$$\ln(\text{prempercap}) = \beta_0 + \beta_1 \ln(\text{incpercap}) + \mu$$

Multiple Regression (Unrestricted):

$$\ln(\text{prempercap}) = \beta_0 + \beta_1 \ln(\text{incpercap}) + \beta_2 \text{lifeexp} + \beta_3 \text{youthdep} + \beta_4 \text{elderlydep} + \beta_5 \text{intrates} + \beta_6 \text{employ} + \beta_7 \text{lifeshare} + \beta_8 \text{healthexp} + \beta_9 \text{fert} + \beta_{10} \text{housenetsav} + \mu$$

Multiple Regression (Restricted):

$$\ln(\text{prempercap}) = \beta_0 + \beta_1 \ln(\text{incpercap}) + \beta_2 \text{lifeexp} + \beta_3 \text{youthdep} + \beta_4 \text{intrates} + \beta_5 \text{lifeshare} + \beta_6 \text{fert} + \mu$$

Table 1 - Variable Definitions

Label	Variable	Measure	Type
prempercap	Life insurance premium per capita expenditure	US dollar	Dependent
incpercap	Gross National Income per Capita	US dollar	Independent
lifeexp	Life expectancy	Years	Independent
youthdep	Dependency population (0-17) as percent of total population	Percent	Independent
elderlydep	Dependency population (65+) as percent of total population	Percent	Independent
intrates	Long term interest rates	Percent	Independent
employ	Population employed as ratio of total working population	Ratio	Independent
lifeshare	Life insurance as share of the entire insurance market	Percent	Independent
healthexp	Percent of GDP spent on health expenditures	Percent	Independent
fert	Fertility rates	Kids	Independent
housenetsav	Average percentage of income in savings	Percent	Independent

Figure 2 - Descriptive Statistics

Variables	Sample Size	Average	SD	Min	Max
ln(prempercap)	57	7.451735	1.12248	5.196498	10.6982
ln(incpercap)	57	10.53671	.2791125	9.926967	11.11101
lifeexp	57	80.78421	1.818535	74.7	82.9
youthdep	57	16.36009	2.170737	13.07131	21.69542
intrates	57	4.414178	3.593121	.6466666	22.4975
lifeshare	57	57.03158	15.47437	17.2	93.4
fert	57	1.628246	.2708394	1.23	2.06

When discussing regression the Gauss Markov Assumptions must be addressed. For Assumption 1: Linear Parameters, the regressions should linear in parameters, meaning our model will be written as: $Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_k x_k + u$. Assumption 2: Random Sampling says the data used should be random and unbiased. In this model unbiasedness of countries reporting is assumed and data was included for every country that had the information for the desired variables. The equation for a random sample of the population can be shown as: $Y_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \beta_3 x_{i3} + \beta_4 x_{i4} + \beta_k x_{ik} + u_i$. Assumption 3: Zero Conditional Mean states the error, μ, should have an expected value of zero for any values of the independent variables. This is assumed to be satisfied in the models. Assumption 4: No Perfect Collinearity states that variable are not to be perfectly correlated. In choosing the variables we were careful to ensure that while they were correlated, it was not in a linear fashion. This lack of perfect collinearity can be seen in the correlation Table 3. Assumption 5: Homoskedasticity states the error, μ, should have the same variance for all independent variables. This is assumed to be satisfied in the models. All Gauss Markov Assumptions have been satisfied in the models showing unbiasedness and the smallest variance among independent variables.

Table 3 - Variable Matrix of Correlation

	Ln(incpercap)	lifeexp	youthdep	intrates	lifeshare	fert
Ln(incpercap)	1.0000					
lifeexp	0.5330	1.0000				
youthdep	0.4087	0.0578	1.0000			
intrates	-0.5590	-0.2304	-0.0710	1.0000		
lifeshare	0.1487	0.2189	0.1114	-0.1524	1.0000	
fert	0.5137	0.2057	0.8560	-0.2462	0.0814	1.0000

Results

The results for the simple regression, unrestricted multiple regression, and restricted multiple regression can be seen in Table 4. The table includes the OLS coefficient with the associated t-statistics in parentheses, the intercept for the models, the number of observations and the R^2.

Simple Regression:

$$\ln(\text{prempercap}) = -23.2407 + 2.912906 \ln(\text{incpercap})$$
$$(3.940833) \qquad (.3738811)$$

For the simple regression the dependent variable is the natural log of the life insurance premium per capita expenditure with the natural log of the gross national income per capita as the independent variable. This analysis with the natural log of both the independent and dependent variable was chosen based on the how the data points are related (Exhibit 2). By taking the natural log of both variables the change in these variables are now understood as percentage change in the dependent variable is equal to β_1 time the percent change in the independent variable or, $\Delta\%\text{prempercap} = \beta_1 \Delta\%\text{incpercap}$. Based on the result from the simple regression one percentage point change in the amount spent on life insurance premium per capita is equal to 2.91 times one percentage point change in national income per capita. The negative intercept shows that there is a threshold where the national income per capita needs to be in order to cause an increase in the premium per capita spent on life insurance. The positive correlation between national income per capita and the life insurance premium per capita supports our hypothesis and was proven statistically significant at all levels allowing the rejection of the null hypothesis.

Multiple Regression (Unrestricted):

$$\ln(\text{prempercap}) = -23.38095 + 1.720404\ln(\text{incpercap}) + .1074591\text{lifeexp} + .3487719\text{youthdep}$$
$$(4.531855) \qquad (.5451931) \qquad (.0512331) \qquad (.1558708)$$

$$+.048006\text{elderlydep} - .0636717\text{intrates} - .0117058\text{employ} + .0255788\text{lifeshare} -$$
$$(.070257) \qquad (.0350763) \qquad (.0187864) \qquad (.0255788)$$

$$.0427074\text{healthexp} - 1.673348\text{fert} + .0233322\text{housenetsav}$$
$$(.0975105) \qquad (.928389) \qquad (.0202173)$$

The unrestricted multiple regression model has the same dependent variable, natural log of the life insurance premium per capita expenditure, as the simple regression. Looking at the results it can be seen that there are four variables that are not statistically significant, and failing to reject the null hypothesis and thus not being statistically significantly different than zero. These four independent variables are: employment rate, health expenditure , elderly dependency ratio, and household net savings. Using the robustness test, $F = [(R^2_{UR} - R^2_R)/q]/[(1 - R^2_{UR})/(n - k - 1)]$, a value of .7602. With

a F-statistic of .7602 for the robustness test we fail to reject the null hypothesis and prove that these four variable are not jointly statistically significant. Due to their lack of statistical significance the four variables were dropped leaving six variables for the restricted model.

Multiple Regression (Restricted):

ln(prempercap)= -22.45883 + 1.684243ln(incpercap) + .1057662lifeexp + .2853542youthdep
(3.999587) (.4120594) (.0500489) (.0704388)

-.0614672intrates + .0271333lifeshare - 1.427669fert
(.0258364) (.0048481) (.5709396)

Based on the findings from the unrestricted model, we are left with six independent variables, all of which are statistically significant at 1% or 5%. Four of the six variables, log of gross national income per capita, life expectancy, youth dependency, and life insurance share of the market, are positively correlated to the percentage of life insurance premiums per capita. The other two variables, long term interest rates and fertility rates, are both negatively correlated to the percentage of life insurance premiums per capita. Unlike the log-log relationship between the natural log of life insurance premiums per capita and natural log of gross national income per capita, the other independent variables in the model have a log-level relationship with the dependent variable that looks like $\Delta\%\text{prempercap} = \beta_k \bullet 100\, \Delta X_k$, ceteris paribus.

When first looking at the independent variables involved it was assumed that they would all have a positive correlation with the dependent variable. The number of young dependents, income, life expectancy, and the life insurance share of the insurance market all seemed to increase an individual's demand for life insurance. The negative correlation of interest rates may be due to the fact that a high interest rate may sway individuals to invest their money elsewhere than in life insurance. While a decrease in interest rates could cause an individual to move their investments into life insurance versus in a low earning investment. The negative correlation between fertility rates and life insurance premiums per capita could be explained by the fact that the average fertility rate of 1.62 is below that which is needed to maintain a population, 2.1. This low level of fertility rates maintaining the population means that not all adults have a younger dependent which means that they have a lesser incentive purchase insurance, or need less insurance thus lowering the premium cost per capita.

Table 4 - Results Table

Variable	Simple Regression	Multiple Regression (Unrestricted)	Multiple Regression (Restricted)
incpercap	2.912906*** (7.79)	1.720404*** (3.16)	1.684243*** (4.09)
lifeexp	-	.1074591** (2.10)	.1057662** (2.11)
youthdep	-	.3487719** (2.24)	.2853542*** (4.05)
intrates	-	-.0636717* (-1.82)	-.0614672** (-2.38)
lifeshare	-	.0255788*** (4.64)	.0271333*** (5.60)
fert	-	-1.673348* (-1.80)	-1.427669** (-2.50)
employ	-	-.0117058 (-.62)	-
healthexp	-	-.0427074 (-.44)	-
elderlydep	-	.048006 (.68)	-
housenetsav	-	.0233322 (1.15)	-
Intercept	-23.2407*** (-5.90)	-23.38095*** (-5.16)	-22.45883*** (-5.62)
Observations	57	57	57
R^2	.5246	.8094	.7968

(*) reject null at 10% significance level (**) reject null at 5% significance level (***) reject null at 1% significance level

Conclusion

The demand for life insurance is a customer driven market that is entirely based on what the customer desires and can possibly be considered a luxury good because of its nature. Due to the functionality of life insurance the driving forces behind it can be identified and focused in a manner different than other essential goods because the demand is completely optional. The complete freedom to choose when and how much to purchase makes interpreting and understanding the correlations an important aspect for suppliers. Knowing what drives the demand in a market and how the price point changes with the economic environment is key for targeting customers and making the most profits. This paper focuses heavily on the demand side of the market with a small amount of insight into the supply side.

The demand side driven variables such as gross national income per capita, life expectancy, youth dependency rate, and fertility rate show how the customer's life changes can change their demand for life insurance. As seen, on a national level a percentage increase in gross national income per capita is positively correlated with a percent change in the premium per capita expenditure. This correlation was the center of the model and this positive correlation provides evidence supporting the hypothesis that an increase in income increases the demand for life insurance. The other demand side variables such as youth dependency and life expectancy have a lower but still positive correlation with a percentage increase in the demand for life insurance. Youth dependency had a higher effect than life expectancy, showing that having dependents drives the individual to protect them regardless of life expectancy.

The supply side variables such as long term interest rates and market share give a less colorful picture on what might be going on in terms of the market. Long term interest rates having a negative correlation was surprising and leads us to believe the customer might be choosing to invest elsewhere thinking they can get a higher return through that medium. The positive correlation of the life insurance share of the insurance market is expected, but the effect might be in the opposite direction as in the more people spend on life insurance means the more of the insurance market life insurance holds.

In conclusion, the models constructed in this paper provide evidence to support the hypothesis that income has a positive relationship with amount spent on life insurance premiums in OECD countries.

Resources

Basurto, G., Romero, H., & Ozbiyik, I. (2012, April 1). Global Insurance Market Trends 2012. Retrieved March 15, 2015, from http://www.oecd.org/pensions/GlobalInsuranceMarketTrends2012.pdf

Donghui, L., Moshirian, F., Nguyen, P., & Wee, T. (2007). *The Demand for Life Insurance in OECD Countries, 74*(3), 637-652. Retrieved April 1, 2015, from http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1539-6975/issues

Liebenberg, A., Carson, J., & Dumm, R. (2012). *A Dynamic Analysis of the Demand for Life Insurance, 79*(3), 619-644. Retrieved April 1, 2015, from http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1539-6975/issues

OECD. (n.d.). Insurance indicators. Retrieved April 16, 2015, from http://stats.oecd.org/Index.aspx?DatasetCode=INSIND

Appendix

Exhibit 1 Countries in Model

Countries
Australia
Belgium
Canada
Czech Republic
Denmark
France
Germany
Greece
Hungary
Ireland
Italy
Japan
Korea
Luxembourg
Netherlands
Norway
Portugal
Spain
Sweden
Switzerland
United Kingdom
United States

Figure 2 - Graphs of prempercap and incpercap relationships

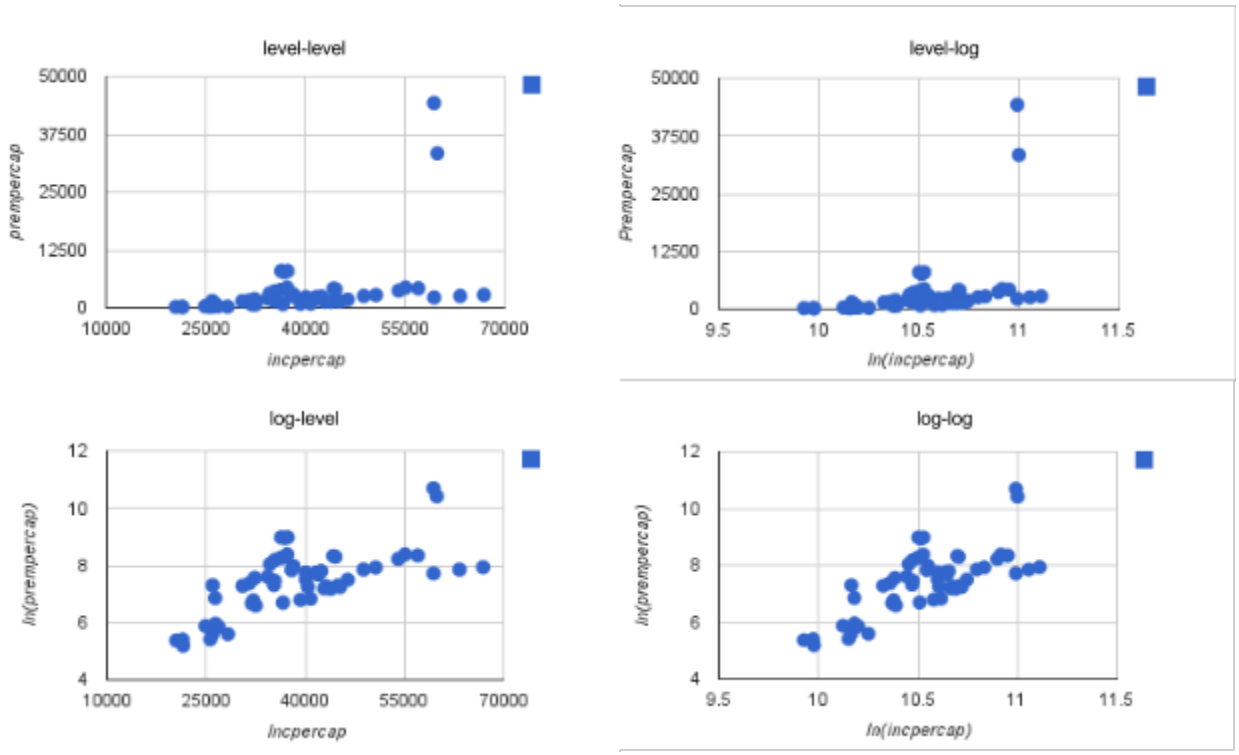

Figure 3 - STATA Output Simple Regression

Source	SS	df	MS
Model	37.016847	1	37.016847
Residual	33.5410187	55	.609836703
Total	70.5578657	56	1.25996189

Number of obs	= 57
F(1, 55)	= 60.70
Prob > F	= 0.0000
R-squared	= 0.5246
Adj R-squared	= 0.5160
Root MSE	= .78092

lnprempercap	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnincpercap	2.912906	.3738811	7.79	0.000	2.163631	3.66218
_cons	-23.2407	3.940833	-5.90	0.000	-31.1383	-15.34309

Figure 4 - STATA Output Multiple Regression (Unrestricted)

Source	SS	df	MS		
Model	57.1074733	10	5.71074733	Number of obs	= 57
Residual	13.4503924	46	.292399835	F(10, 46)	= 19.53
Total	70.5578657	56	1.25996189	Prob > F	= 0.0000
				R-squared	= 0.8094
				Adj R-squared	= 0.7679
				Root MSE	= .54074

lnpremppercap	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnincpercap	1.720404	.5451931	3.16	0.003	.6229871	2.817821
lifeexp	.1074591	.0512331	2.10	0.041	.0043322	.2105861
youthdep	.3487719	.1558708	2.24	0.030	.0350202	.6625235
elderlydep	.048006	.070257	0.68	0.498	-.0934141	.1894261
intrates	-.0636717	.0350763	-1.82	0.076	-.1342766	.0069332
employ	-.0117058	.0187864	-0.62	0.536	-.0495208	.0261093
lifeshare	.0255788	.0055128	4.64	0.000	.0144822	.0366755
healthexp	-.0427074	.0975105	-0.44	0.663	-.2389858	.153571
fert	-1.673348	.928389	-1.80	0.078	-3.542098	.1954023
housenetsav	.0233322	.0202173	1.15	0.254	-.0173631	.0640276
_cons	-23.38095	4.531855	-5.16	0.000	-32.5031	-14.2588

Figure 5 - STATA Output Multiple Regression (Restricted)

Source	SS	df	MS		
Model	56.2175921	6	9.36959868	Number of obs	= 57
Residual	14.3402736	50	.286805472	F(6, 50)	= 32.67
Total	70.5578657	56	1.25996189	Prob > F	= 0.0000
				R-squared	= 0.7968
				Adj R-squared	= 0.7724
				Root MSE	= .53554

lnpremppercap	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnincpercap	1.684243	.4120594	4.09	0.000	.856597	2.511888
lifeexp	.1057662	.0500489	2.11	0.040	.0052401	.2062924
youthdep	.2853542	.0704388	4.05	0.000	.1438737	.4268348
intrates	-.0614672	.0258364	-2.38	0.021	-.1133612	-.0095733
lifeshare	.0271333	.0048481	5.60	0.000	.0173956	.036871
fert	-1.427669	.5709396	-2.50	0.016	-2.574435	-.2809033
_cons	-22.45883	3.999587	-5.62	0.000	-30.49223	-14.42542